5
RECOMMENDED RAPID VISUAL SCREENING PROCEDURE

This section presents and discusses the elements of a recommended RSP, based on the results of the survey discussed above.

5.1 Elements of the Recommended RSP

In response to the conclusions (Section 4.7) reached from the survey of RSPs, an RSP employing the following elements is recommended:

- The Effective Peak Acceleration (EPA) values contained in the National Earthquake Hazards Reduction Program (NEHRP) Recommended Provisions for the Development of Seismic Regulations for New Buildings (BSSC, 1985), defined by Map Area, as an explicit measure of the ground motion.
- The building types contained in ATC-14 (i.e., wood frame, 5 steel types, 3 reinforced concrete, 2 pre-cast, 2 reinforced masonry, and 1 unreinforced masonry types).
- A systematic, simple structural hazard analysis scheme, based on a non-arbitrary measure of building performance for the specific building given the occurrence of the EPA. This scheme consists of a Basic Structural Hazard score, modified by penalties and bonuses to account for perceived deficiencies or strengths because of such factors as design level (inferred from age), condition, and configuration. The scheme involves only simple arithmetic, the score and penalties being added, to arrive at a final Structural Score S (A high score corresponds to a low structural hazard, or is "good," and vice-versa.) The resulting S will relate back to the physical performance of the building, in terms of damage. (The basis for S is discussed further below).
- A simple clipboard data collection form, with space for:
  - a photograph of the building
  - a field sketch of the building
  - data from pre-field visit information (e.g., a summary from the Assessor's or other files, giving address, age, value, or owner's name, perhaps printed on a peel-off label that can be affixed directly to the data collection form)
  - a checklist of items (so that significant items are not omitted), with almost all input to be noted by circling of the appropriate item (so that standard notation is employed)
  - the simple calculation for S

This form and process is to be accompanied by a handbook (ATC-21) explaining its use and providing

- information on how to determine which of the building types is most appropriate for the particular building being surveyed
- explanations and guidance as to the recognition of various significant factors, such as pounding, poor configuration, or soft stories

- a summary sheet of basic information, for quick reference in the field

5.2 Basis for Structural Hazard Scores

It has been emphasized in the above that the Structural Hazard score should be rationally based and physically meaningful. It is recommended that it should be *a measure of the probability of major seismic damage to the building*. Major damage is taken to be direct physical damage being 60% or greater of the building value. (Note: definitions of building value, and related terms are similar to those in report ATC-13, (ATC, 1985), "*Earthquake Damage Evaluation Data for California*").

Sixty percent as heavy damage is selected because (i) it is the lower end of the Major Damage State in ATC-13, (ii) if 60 percent of a building's value is damaged, experience has shown that demolition rather than repair often ensues, and (iii) if 60 percent damage is selected, then most buildings likely to collapse will be included in this category, so that life-safety-related hazardous buildings (due to shaking) are probably all captured.

By employing NEHRP EPA values as the measure of ground motion, ATC-13 relations can be used to determine the probability of occurrence of 60 percent or greater damage, given that input ground motion (see Appendix B for details). The determination of the Basic Structural Hazard score then is:

Basic Structural Hazard score =
–log (probability of damage >= 60%) (1)

If the probability of the damage exceeding 60%, given the NEHRP EPA value for the building's site, is, for example, .001, then the Basic Structural Hazard score is 3. If the probability is .01, then it is 2, and so on.

- Although quite simple, the Basic Structural Hazard score is thus intuitively satisfying. A relatively "safe" building would have values of 3 to 5 in California, whereas the identical building would score approximately 7 to 10 in NEHRP Map Area 3, corresponding to New England or the South Carolina regions, as it is likely to experience less severe ground motion. Note, however, that because many buildings in less seismic areas are not designed for earthquake on the same basis as in California, when this is taken into account the resulting score is more consistent for the same building type in different NEHRP map areas (e.g., in the range of 3 to 5). Values of the Basic Structural Hazard score are provided in Table B1, Appendix B.
- The Basic Structural Hazard score can be easily and directly related back to the probability of major physical damage (i.e., damage exceeding 60 percent of building value).
- The Basic Structural Hazard score will likely prove of value in community cost-benefit decision making because it can be directly related to physical damage.
- The ability to relate Basic Structural Hazard score to physical damage has the further virtue of providing a rational analytical basis for quantifying structural penalties for factors such as age, and configuration. If the impact of these factors on the likelihood (or probability) of major damage can be quantified, then the logarithm of this quantity is the modifier. Although lack of data and the present state of the art may preclude general quantification of the effect of a factor such as "soft story" at present, as new data emerge on the effect of this factor, its quantification can be directly related to a penalty on the Basic Structural Hazard score. In the interim, discussion and expert opinion/elicitation regarding the effect of this factor can take place within the framework of

trying to quantify the impact of this factor on the probability of major damage.

5.3 Data Collection Form

This section discusses the layout and use of data collection form, which is shown in Figure 1. The form would be carried in the field in a binder or clipboard.

Basic Information

Space is provided in the upper right of the form for basic information, much of which might be collated and printed out prior to the field visit. Information desired includes address, zip code (although often lacking from the studies reviewed, this is a useful item), the date of the survey, and identity of the surveyor. Additional useful information about the building such as age, construction type, soil type, and value is also desirable. Preferably, such information should either be computer-printed out directly onto the form, or onto a peel-off label applied by the field surveyor. This information would be quickly entered or affixed as the first item upon coming to the building.

Photograph

A general photo of the building should be taken, showing two sides of the building, if possible. (This would preferably be an "instant" type photo, to avoid the task of later collating photos with forms.)

Sketch

The surveyor would then sketch the building (plan and elevation, or oblique view) indicating dimensions, facade and structural materials, and observed special features such as cracks, lack of seismic separation between buildings, roof tanks, cornices, and other features. This sketch is important, as it requires the surveyor to carefully observe the building.

Building Information

Following this, the surveyor would fill in additional basic information specific to the building such as number of stories; an estimate of the building age (e.g., 1930's or late 1960's), the occupancy (e.g., residential, office, retail, wholesale/warehouse, light industrial, heavy industrial, public assembly such as auditoria or theaters, governmental); and an estimate of the number of persons typically in the building under normal occupancy. For example, for a residence, this would be the number of persons living there (not the daytime population); for an office this would be the daytime population; for a theater this would be the seating capacity.

Basic Structural Hazard Score

Next, based on observation, the surveyor would make a determination of the primary structural material (wood, steel, concrete, pre-cast, reinforced masonry or unreinforced masonry) and circle the appropriate Basic Structural Hazard score. The basis for determination of Basic Structural Hazard scores are given in Appendix B. The building types follow the building category scheme of ATC-14 (ATC, 1987).

Wood

W = wood (low-rise (LR) only, W1 and W2 treated together)

Steel

S1 = moment resisting frame
S2 = steel frame with steel bracing
S3 = light metal (LR only)
S4 = steel frame with concrete shear walls
S5 = steel frame with unreinforced masonry infill walls

Concrete

C1 = moment resisting frame
C2 = shear wall
C3 = concrete frame with unreinforced masonry infill walls

Precast

PC1 = tilt-up (LR only)
PC2 = precast concrete frames

Reinforced Masonry

RM = reinforced masonry buildings of all types, differentiated only by height

Unreinforced Masonry

URM = unreinforced masonry bearing wall (LR and mid-rise (MR) only).

Any specific jurisdiction corresponds to one NEHRP Map Area, and the form used in the field for that jurisdiction would have Structural Scores corresponding only to that Map Area/jurisdiction. All NEHRP Map Areas and corresponding Structural Scores would be furnished in the Handbook.

Confidence

If in doubt as to which category is most appropriate for a particular building, the surveyor should record the possible categories and mark them with an asterisk (*) to indicate the subjective evaluation.

If the surveyor cannot narrow the estimate to two alternates, DNK = Do Not Know should be indicated, signifying that the basic structural material or system cannot be identified from the street. DNK would also apply for a building of mixed construction, where no one category predominates. DNK constitutes a default, indicating that the building and drawings should be reviewed in detail.

Modifiers

Negative modifiers corresponding generally to deficiencies such as poor configuration, pounding, and potential for a neighboring building collapsing onto this building (this penalty would depend on the Basic Structural Hazard score for the neighboring building being sufficiently low as to indicate a potential for collapse, and the height and proximity of the neighboring building being such as to indicate that collapse might affect the subject building).

Soil Profile

Modifiers assigned for adverse soil conditions when the soil profile can be identified with some confidence. Soil profiles have been defined according to the NEHRP Recommended Provisions for the Development of Seismic Regulations for New Buildings (BSSC, 1985):

SL1: Rock or stiff soils less than 200 feet deep overlying rock

SL2: Deep, cohesionless soil or stiff clay conditions exceeding 200 feet depth

SL3: Soft- to medium-stiff clays and sands, exceeding 30 feet in thickness

Structural Score S

Lastly, the Structural Score S is computed by simple addition of the modifiers to the Basic Structural Hazard score. The final Structural Score S is recorded.

5.4 Use of the Results

For any building, the final Structural Score S will typically be a number between 0 and 5 or more, depending on NEHRP Map Area. All buildings surveyed can thus be ranked according to S, and a decision made as to a "cut-off" S. Buildings that score below the cut-off would be subjected to more detailed review. Scoring above the cut-off does not signify a "safe" building, but instead indicates that for the particular community the building is assumed sufficiently safe, and no further review is required.

An appropriate value for the cut-off S is a complex decision, involving financial and ethical questions. Appendix C provides recommendations for a cut-off S. This recommendation should be reviewed and, if necessary, modified by a jurisdiction, as the decision has cost implications. (That is, a relatively high cut-off involves detailed review of a large number of buildings, with increased costs and presumably eventual increased seismic safety, assuming buildings determined to be unsafe are cited and abated. A lower cut-off has lower costs for building review, but may involve lower resulting seismic safety.)

ATC-21/ (NEHRP Map Areas 5,6,7 High)	Address ____________________ Zip____
Rapid Visual Screening of Seismically Hazardous Buildings	Other Identifiers ____________________
	No. Stories ________ Year Built ________
	Inspector ________ Date ________
	Total Floor Area (sq. ft)____________
	Building Name ____________
	Use ____________
	(Peel-off label)
Scale:	INSTANT PHOTO

OCCUPANCY

	No. Persons
Residential	
Commercial	0–10
Office	11–100
Industrial	100+
Pub. Assem.	
School	
Govt. Bldg.	
Emer. Serv.	
Historic Bldg.	

Non Structural Falling Hazard ☐

DATA CONFIDENCE

☆ = Estimated, Subjective, or Unreliable Data

DNK = Do Not Know

STRUCTURAL SCORES AND MODIFIERS

BUILDING TYPE	W	S1 (MRF)	S2 (BR)	S3 (LM)	S4 (RC SW)	C1 (MRF)	C2 (SW)	C3/S5 (URM INF)	PC1 (TU)	PC2	RM	URM
Basic Score	4.5	4.5	3.0	5.5	3.5	2.0	3.0	1.5	2.0	1.5	3.0	1.0
High Rise	N/A	−2.0	−1.0	N/A	−1.0	−1.0	−1.0	−0.5	N/A	−0.5	−1.0	−0.5
Poor Condition	−0.5	−0.5	−0.5	−0.5	−0.5	−0.5	−0.5	−0.5	−0.5	−0.5	−0.5	−0.5
Vert. Irregularity	−0.5	−0.5	−0.5	−0.5	−0.5	−1.0	−0.5	−0.5	−1.0	−1.0	−0.5	−0.5
Soft Story	−1.0	−2.5	−2.0	−1.0	−2.0	−2.0	−2.0	−1.0	−1.0	−2.0	−2.0	−1.0
Torsion	−1.0	−2.0	−1.0	−1.0	−1.0	−1.0	−1.0	−1.0	−1.0	−1.0	−1.0	−1.0
Plan Irregularity	−1.0	−0.5	−0.5	−0.5	−0.5	−0.5	−0.5	−0.5	−1.0	−1.0	−1.0	−1.0
Pounding	N/A	−0.5	−0.5	N/A	−0.5	−0.5	N/A	N/A	N/A	−0.5	N/A	N/A
Large Heavy Cladding	N/A	−2.0	N/A	N/A	N/A	−1.0	N/A	N/A	N/A	−1.0	N/A	N/A
Short Columns	N/A	N/A	N/A	N/A	N/A	−1.0	−1.0	−1.0	N/A	−1.0	N/A	N/A
Post Benchmark Year	+2.0	+2.0	+2.0	+2.0	+2.0	+2.0	+2.0	N/A	+2.0	+2.0	+2.0	N/A
SL2	−0.3	−0.3	−0.3	−0.3	−0.3	−0.3	−0.3	−0.3	−0.3	−0.3	−0.3	−0.3
SL3	−0.6	−0.6	−0.6	−0.6	−0.6	−0.6	−0.6	−0.6	−0.6	−0.6	−0.6	−0.6
SL3 & 8 to 20 stories	N/A	−0.8	−0.8	N/A	−0.8	−0.8	−0.8	−0.8	N/A	−0.8	−0.8	−0.8
FINAL SCORE												

COMMENTS

Detailed Evaluation Required?

YES NO

Figure 1. Data Collection Form